PROJECT NUMBER: 1702
PROJECT TITLE: Aerosol Generation and Filtration
PROJECT LEADER: K. A. Cox
PERIOD COVERED: July, 1987

I. OPTICAL PROCESSING

A. Objective: Develop optical processing methods for pack inspection

B. Results:

Optical Processing Laboratory (C. Harward)
The renovation of D-109 for the optical processing laboratory is very near completion. Almost all of the equipment ordered for the laboratory has been received and moved into the lab. The imaging system to be used for the acquisition of digital images of cigarette packs has been set up and tested by the Computer Application Division personnel (R. Maher). Electronic problems have been encountered with the imaging board and a replacement requested from the vendor. Once an ethernet board is installed and tested, the system will be transferred to the optical lab.

Evaluation of a Commercial System for Pack Inspection
Global Holonetics of Fairfield, Iowa has developed a system that uses optical processing techniques for on-line inspection problems. It was evaluated and found to show promise for the inspection of cigarette packs. A system will be obtained for further evaluation in manufacturing when it becomes available.

Numerical Methods Development (K. Cox)
The Design of one or more of the components of an optical pack inspection system requires a number of 'training images' of acceptable and unacceptable packs as well as some numerical algorithm for determining the design specifications of the optical components from the training images. In particular, one very promising optical inspection system uses a synthetic discriminant function as a matched spatial filter in a correlator. The filter is a computer generated hologram (CGH) which must be designed so that the system output contains a peak of unit height for acceptable images but no peak for unacceptable images. A numerical algorithm for designing such a CGH has been developed. The new algorithm is expected to overcome some of the deficiencies of earlier approaches, allowing for larger training sets, high resolution images and small differences between acceptable and unacceptable images.

C. Plans: Establish a library of video images of both acceptable and unacceptable packs. Focus initially on three different pack types.

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II. SIDESTREAM SMOKE MEASUREMENTS (C. Morgan)

A. **Objective**: Carry out a systematic investigation of the effects of cigarette design parameters on sidestream visibility, particulate generation rate, and mean particle size.

B. **Results**: We have found it informative to report a new quantity, the RPF (relative particulate fraction), in addition to the MBR (mass burn rate) and sidestream visibility. The RPF is defined to be the fraction of the mass released into the air that is the form of a visible aerosol. This number ranges from .012 to .058 and is a measure of the efficiency of the cigarette for converting its mass into a visible aerosol (a low efficiency is desirable). At constant aerosol particle size, the visibility (extinction coefficient at the Mercury green line) should be proportional to the product of MBR and RPF. The division is useful since it allows us to separate the more trivial reduction in visibility which results from a reduction in MBR from the more interesting reduction which results from a reduction in the RPF. Of the cigarettes we have examined, those made from wrappers containing $Mg(OH)_2$ exhibit the smallest RPF.

III. SUBJECTIVE IMPACT OF ENHANCED VAPOR DELIVERY (D. Simpson)

A. **Objective**: Design a series of cigarettes which, at a given puff position, have identical TPM delivery, RTD, dilution and mean aerosol particle size, but distinctly different vapor/particulate ratios. Evaluate for subjective differences.

B. **Results**: A series of cigarettes (series A) with conventional CA filters (designed earlier) have been fabricated and submitted for RTD selection. A second series of cigarettes (series B) employing impactor filters have been designed and drawings made of the filter elements (Dick Cosner).

C. **Plans**: Submit the series A cigarettes for puff x puff and vapor/particulate analysis in order to determine if the design targets have been achieved. Machine a small number of the impactor filters for series B and submit the cigarettes for similar analysis.

IV. REMOTE SENSING OF FILLER DENSITY (T. Nguyen)

A. **Objective**: Evaluate the potential of light transmission measurements for the remote sensing of the density of tobacco filler.

B. **Results**: We have previously derived an equation describing the dependence of the extinction coefficient of a bed of tobacco on the density of the bed and the size of the shreds comprising it. The extinction coefficient of a 6 mm deep bed of tobacco was measured over a range of densities and found to be well described by the equation.

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C. **Plans**: Repeat the extinction measurements for a bed of depth equal to that which would be encountered on a cigarette maker. Determine the accuracy with which a density measurement could be made as a function of the cross sectional area of the beam presented to the bed.

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